

ORIGINAL ARTICLE

A PROSPECTIVE COMPARISON OF NON-OPERATIVE AND OPERATIVE MANAGEMENT OF HUMERUS MID-SHAFT FRACTURES

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Background: Humerus shaft fractures are common long bone fractures and the treatment options range from conventional plaster application to plate osteosynthesis. This study aimed to determine outcomes of non-operative vs operative techniques in managing mid-shaft humerus fractures. **Methods:** This randomized control trial was conducted in Department of Orthopaedics, Ayub Teaching Hospital, Abbottabad, from 10 Oct 2022 to 9 Apr 2023. Patients aged 20–70 years with unilateral, displaced, and closed humeral shaft fracture were included using non-probability consecutive sampling, after approval of hospital ethical committee and written informed consent of patients. Patients were randomly divided into two groups. Patients in group A were treated with operative technique and patients in group B were treated with non-operative technique. Outcomes were observed on 12 weeks' follow-up. Data was entered and analyzed using SPSS-22. **Results:** One-hundred-fifty patients were enrolled, 75 patients in each group. Mean age was 43.75 ± 14.7 years in group A and 40.64 ± 14.9 years in group B. There were 58.7% males in group A and 61.3% in group B. Females were 41.3% in group A and 38.7% in group B. In group A non-union was present in 5.3%, malunion in 10%, and radial nerve injury in 5.3% patients. In group B non-union was present in 17.3%, malunion in 26.7% and radial nerve injury in 21.3% patients. All these showed statistically significant difference with p -value 0.020, 0.041 and 0.004 respectively. **Conclusion:** Operative technique is better than non-operative technique in management of mid-shaft humerus fracture.

Keywords: High energy trauma, Humerus fracture, Internal fixation, Non-operative technique, Open reduction

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INTRODUCTION

Humeral shaft fractures account for 1–3% of all fractures.¹ Globally reported annual incidence is 12 per 100,000 adults.² They are usually caused by simple falls, motor vehicle crashes, and sports injuries.³ Humeral shaft fractures have a bimodal age distribution with the first peak seen in men aged 21 to 30 years following high-energy trauma, commonly resulting in comminuted fractures with associated soft tissue injuries. The second peak is witnessed in women aged 60 to 80 years, typically following low-energy trauma.⁴ Fractures caused by low-energy trauma, such as fall from standing height, should raise the suspicion of poor bone quality associated with osteoporosis or oncologic disease. Patients present with pain, disability, a swollen upper extremity and visible deformity.⁴ The skin must be carefully inspected to rule out an open wound. The initial neurological examination is then carried out, specifically focusing on radial nerve function. It is critical to establish and record the baseline function of the radial nerve. The first examination can be limited by pain and therefore it is essential to repeat this after pain control has been achieved. It is also mandatory to reassess the radial nerve function before and after any manipulation and/or treatment (cast, surgery, etc.).⁴

The treatment of humeral shaft fractures is still controversial. In most of these fractures, treatment is

nonsurgical.⁵ Controversies still exist whether surgical intervention is needed for humeral shaft fractures. Surgical treatment is generally recommended for fractures with large displacement angles, multiple fractures, comminuted fractures, and fractures complicated with vascular and nerve injury.^{6,7}

In a study comparing non-operative technique with operative technique, main outcome measures were evaluated retrospectively and included non-union, malunion and incidence of radial nerve palsy. The occurrence of non-union and malunion was statistically significant and more common in the non-operative group.⁸

Mid-shaft humerus fractures are very common in our population¹ and its treatment is mainly non-operatively as described in previous studies.^{6,7} But risk of radial nerve injury make it necessary to review our treatment plan.⁸ The objective of this study was to determine and compare outcome of non-operative and operative techniques in managing mid-shaft humerus fracture. Our results will help development of best practice guidelines for management of mid-shaft humerus fractures.

MATERIAL AND METHODS

A randomized control study was carried out at Department of Orthopaedics, A Ward, Ayub Teaching

Hospital Abbottabad from 10 Oct 2022 to 9 Apr 2023. Non-probability consecutive sampling technique was used. Sample size was calculated using WHO Sample Size Calculator keeping 80% power of study, 10% absolute precision, keeping mal-union in non-operative as 12.7% and in operative group as 1.3%.⁸ Sample size was 75 patients in each group.

Inclusion criteria was patients aged 20–70 years of either gender who presented with unilateral, displaced, and closed humeral shaft fracture, as seen on X-ray. Exclusion criteria included pathological fractures and other concomitant injuries affecting the same upper limb. The patients with internal organ, brachial plexus, or vascular injury requiring surgery and poly-trauma patients were excluded.

After approval from hospital ethical board, patients fulfilling the inclusion criteria were enrolled from surgical emergency of Ayub Teaching Hospital, Abbottabad. A written informed consent was taken after explaining the purpose of study. Demographic data including age, gender and duration of injury was recorded. Complete history was taken and physical examination was done.

Patients were randomly divided into 2 groups using block randomization. Patients in group A were treated surgically. A standard open reduction and internal fixation was carried out with plate and screws (Figure-1). The surgery was performed within 14 days of the fracture. Patients were allowed to move their arm immediately postoperatively but were instructed to avoid weight-bearing until 6 weeks after surgery. In group B, patients were treated non-operatively. First, hanging slap was advised for 7 to 10 days; that was converted to functional brace after pain control. Trained plaster technician applied a functional brace that covered the arm from shoulder to elbow but left the motion of both these joints free. Patients were given instructions on how to cope with the brace and how to tighten it as the swelling subsided and were instructed to wear the brace until fracture union. Active non-weight-bearing exercises of the elbow and hand and pendulum exercises of the shoulder was allowed immediately, followed by assisted exercises of the shoulder at 3 weeks, and finally, gradual weight-bearing at 6 weeks.

At the end of 12 weeks patients were assessed in out-patient department for union, malunion and radial nerve injury. Data was entered in specially designed proforma. Non-union was defined as absence of bridging fracture callus in 3 of the 4 cortices on digital X-ray humerus (AP and lateral view). Mal-union was defined as varus angulation of humerus at the fracture site. Radial nerve injury meant presence of wrist drop and loss of sensations in lateral aspect of arm.

Data was entered and analysed using SPSS-22. Mean and standard deviations were calculated for quantitative variables like age and duration of injury.

Frequency and percentage were calculated for categorical variables. Outcome was compared in both groups using Chi-square test, and $p \leq 0.05$ was taken as statistically significant.



Figure-1: (a) X-ray of mid-shaft humerus; (b) Postop X-ray of same patient after ORIF with broad DCP

RESULTS

Total 150 patients were enrolled in the study, 75 patients in each group. Mean age of the patients was 43.75 ± 14.7 years in group A and 40.64 ± 14.9 years in group B. There were 58.7% males in group A and 61.3% in group B, females were 41.3% in group A and 38.7% in group B. Mean duration of injury was 5.65 ± 2.2 days in group A and 5.5 ± 2 days in group B. none of these preoperative measurements differed significantly among the study groups. (Table-1).

In group A non-union was present in 5.3%, which was significantly lower than the non-union in the group B ($p=0.020$). Malunion rate was significantly lower in group A, i.e., 10% compared to rate in non-operative group (26.7%), ($p=0.041$). Radial nerve injuries were less common in operative group, i.e., 5.3% in comparison with 21.3% in the non-operative group ($p=0.004$). (Table-2).

Table-1: Comparison of preoperative variables among the two management groups

Variable	Group A	Group B	<i>p</i>
Males	44	46	0.739
Females	31	29	
Mean Age (Years)	43.72 ± 14.79	40.64 ± 14.91	0.206
Duration of injury (Days)	5.65 ± 2.26	5.56 ± 2.06	0.792

Table-2: Comparison of outcome variables among management groups

Variable	Group A	Group B	p
Non-union (Yes/No)	4/71	13/62	0.020
Malunion (Yes/No)	10/65	20/55	0.041
Radial nerve injury (Yes/No)	4/71	16/59	0.004

DISCUSSION

Humeral shaft fracture typically occurs following high-energy trauma, commonly resulting in comminuted fractures with associated soft tissue injuries. The second peak is witnessed in women aged 60 to 80 years, typically following low-energy trauma.⁴ Several options are possible for the management of HSF: conservative management, open reduction and internal fixation (ORIF) with a plate, or closed reduction and intramedullary nailing (IMN). An external fixator is also an option, however rarely indicated. Un-displaced or minimally displaced HSF are routinely treated conservatively. In fact, anterior angulation of 20°, a varus or valgus of 30°, 15° of mal-rotation and 3 Cm of shortening have been shown to adequately maintain the upper limb function.⁹ For this reason, fractures that are displaced within these values following immobilization are good candidates for non-operative technique. Union rate with this technique ranges between 77.4% and 100%.¹⁰ In a review including almost 2000 patients, Papasoulis *et al*¹⁰, reported a union rate of 94.5% and a mean time to union of 10.7 weeks. Ali *et al*¹¹, observed an overall union rate of 83% on a series of 138 fractures of the humeral mid-shaft fracture treated with functional bracing. Papasoulis *et al*¹⁰ reported a decrease in clinical scores with a residual deformity of less than 10° of varus in more than 85% of their patients. We compare outcomes of operative versus non-operative management of mid-shaft humerus fracture.

In a study⁸ non-operative technique was compared with operative technique. Main outcome measures were evaluated retrospectively and included non-union, malunion and incidence of radial nerve palsy (RNP). The occurrence of non-union (20.6% vs 8.7%, $p=0.013$) and malunion (12.7% vs 1.3%, $p=0.001$) was statistically significant and more common in the non-operative group.⁸ Union rate after plating ranges from 87% to 96%, with an average time to union of 12 weeks.¹² The complication rate ranges from 5% to 25%,¹³ most commonly found to be non-specific complications such as infection, non-union and malunion. Iatrogenic RNP is a risk with most approaches to the humeral shaft, and Streufert *et al*¹⁴ reviewed 261 HSF treated with ORIF, iatrogenic RNP occurred in 7.1% of anterolateral, 11.7% of triceps-splitting and 17.9% of triceps-sparing approaches. It is vital that the radial nerve is identified and protected in all open dissections.

In a meta-analysis it was found that non-operative management resulted in a significantly higher non-union rate of 17.6% compared to 6.3% with fixation. Operative management had a significantly higher iatrogenic nerve injury rate of 3.4% and infection rate of 3.7%. All non-unions within the included studies went on to union after plate fixation. There were no significant differences in delayed union or patient-reported outcome measures. There was a significantly increased risk of malunion with non-operative treatment, however, this did not correlate with the outcome.¹⁵

STUDY LIMITATIONS

It was a single-centre study with limited number of cases. A multi-centre study with larger study group will provide higher level of evidence that can be used for formulation of best management guidelines.

CONCLUSION

Operative management of mid-shaft fracture of humerus is associated with decreased non-union, malunion and radial nerve injuries compared to conservative management.

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